

CLAIMS

1. An image transformation apparatus for a vehicle rear monitoring device, comprising:

a camera mounted on a vehicle for capturing a rear of the vehicle;

a monitor disposed at a driving seat of the vehicle; and

display control means for transforming an input image that is an image captured by the camera at a time when the vehicle is rolling backward into an output image that is an image assumed to be obtained by capturing the rear at a predetermined inclination at a virtual camera position different from an actual camera position at which the camera is mounted, and displaying the output image on the monitor.

2. An image transformation apparatus for a vehicle rear monitoring device according to claim 1, wherein the display control means includes a function of moving a cut range of the output image with respect to the input image in a parallel direction.

3. An image transformation apparatus for a vehicle rear monitoring device according to claim 1, wherein the display control means enlarges a cut range of the output image with respect to the input image and transforms it into the output image.

4. An image transformation apparatus for a vehicle rear monitoring device according to claim 1, wherein the display control means transforms the input image into the output image from which lens distortion is removed.

5. An image transformation apparatus for a vehicle rear monitoring device according to claim 1, wherein the display control means comprises a transformation table including:

first transformation means for transforming a coordinate value represented on a virtual CCD surface coordinate system at the virtual camera position in the output image into a coordinate value on a ground coordinate system at the virtual camera position;

second transformation means for transforming the coordinate value transformed into the coordinate value on the ground coordinate system at the virtual camera position into a coordinate value represented on the ground coordinate system at the actual camera position shifted only by an offset between a virtual camera optical axis center that is a center of an optical axis of the camera when the camera is assumed to be disposed at the virtual camera position and an actual camera optical axis center;

third transformation means for transforming the coordinate value transformed into the coordinate value on the ground coordinate system at the actual camera position into a coordinate value represented on the actual CCD surface coordinate system at the actual camera position, and

fourth transformation means for transforming the coordinate value transformed into the coordinate value on the actual CCD surface coordinate system into the coordinate value in the input image with lens distortion of the camera added thereto, and

a positional relationship between respective pixels of the output image to be displayed on the monitor and respective pixels of the input image corresponding to the output image is determined based on the transformation table.

6. An image transformation apparatus for a vehicle rear monitoring device according to claim 5, wherein the display control means transforms only the pixels of the input image whose positional relationship is determined based on the transformation table, among the pixels of the input image, based on the transformation table, and displays them on the monitor as an output image.

7. An image transformation apparatus for a vehicle rear monitoring device according to claim 5, wherein the display control means includes image cut range enlarging means for transforming the coordinate value represented on the actual CCD surface coordinate system at the actual camera position by the third transformation means, so as to enlarge a cut range of the output image with respect to the input image on the actual CCD surface, and

transforms the coordinate value transformed by the image cut range enlarging means into a coordinate value of the input image with lens distortion of the camera added thereto by the fourth transformation means.

8. An image transformation apparatus for a vehicle rear monitoring device according to claim 5, wherein the display control means includes image moving means for transforming the coordinate value represented on the virtual CCD surface coordinate system at the virtual camera position in the output image into a coordinate value on a coordinate system that is obtained by moving an origin of the virtual CCD surface coordinate system, and

transforms the coordinate value transformed by the image moving means into a coordinate value on the ground coordinate system at the virtual camera position by the first

transformation means.

9. An image transformation apparatus for a vehicle rear monitoring device according to claim 1, wherein the display control means displays a guide display for supporting an operation of a vehicle when the vehicle rolls backward, in such a manner that the guide display is superimposed on the monitor.

10. An image transformation apparatus for a vehicle rear monitoring device according to claim 9, wherein the guide display is displayed at a predetermined position on a screen of the monitor, and includes a vehicle width guideline showing expected positions of both sides of the vehicle when the vehicle rolls backward in a straight line.

11. An image transformation apparatus for a vehicle rear monitoring device according to claim 9, comprising a steering angle sensor for detecting a steering angle of a steering wheel, wherein the guide display is displayed with movement on the screen of the monitor, and includes a steering path guideline of the vehicle showing an expected position of the vehicle when the vehicle rolls backward at the steering angle of the steering wheel detected by the steering angle sensor.

12. An image transformation apparatus for a vehicle rear monitoring device according to claim 9, comprising a steering angle sensor for detecting a steering angle of a steering wheel, wherein the guide display includes a steering start guideline that is displayed at a predetermined position on a screen of the monitor and made of a line segment for guiding an appropriate steering start position for parking and a steering amount guide mark that is displayed with movement along the

steering start guideline on the screen of the monitor in accordance with a size of the steering angle of the steering wheel detected by the steering angle sensor.

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